CLAIMS

1. A process for producing a hydroxyaldehyde compound, comprising conducting aldol condensation of a substituted or unsubstituted aliphatic aldehyde compound having 2 to 6 carbon atoms with a single molecule of acetaldehyde to produce a hydroxyaldehyde compound having the number of carbon atoms increased by two, using D-2-deoxyribose-5-phosphate aldolase having a property of retaining 50 % or greater of activity after treating at 25°C for 30 minutes in an aqueous medium containing 100 mM of chloroacetaldehyde.

2. The process according to claim 1, wherein the D-2-deoxyribose-5-phosphate aldolase has a feature of either (1) or (2) in the following:

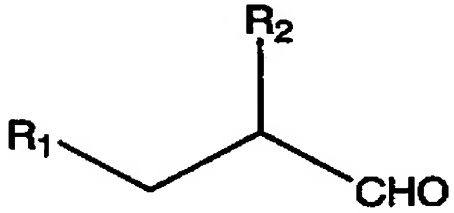
(1) Having an amino acid sequence of SEQ ID NO: 2 or SEQ ID NO.4; and

(2) Having an amino acid sequence of SEQ ID NO: 2 or SEQ ID NO: 4, in which one to several amino acids are deleted or substituted by other amino acid residues, or other amino acid residues are inserted.

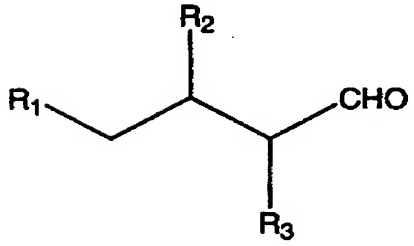
3. The process according to claim 2, wherein the substituted or unsubstituted aliphatic aldehyde compound having 2 to 6 carbon atoms is a compound represented by General Formula (1), General Formula (2) or General Formula (3), and the corresponding aldehyde compound having the number of carbon atoms increased by two, which is obtained by aldol condensation,

is an aldehyde compound represented by General Formula (4), General Formula (5) or General Formula (6), respectively:

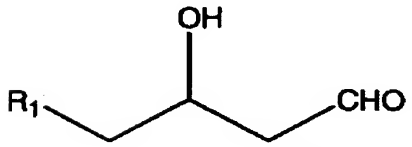
(1)



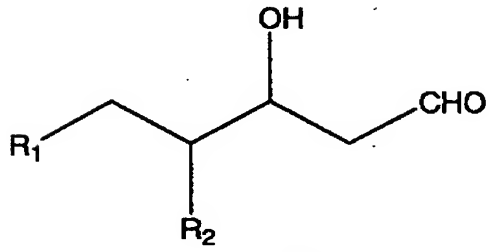
(2)



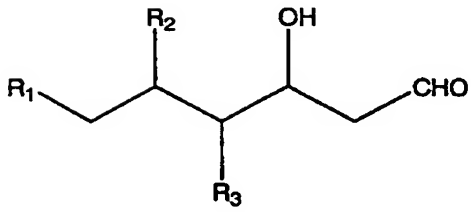
(3)



(4)



(5)



(6)

wherein in General Formula (1) to General Formula (6), R_1 is a hydrogen atom, a hydroxyl group, a halogen atom, an azido group, a carboxyl group, or an alkyl group, an alkoxy group or an alkanoic acid group respectively having 1 to 4 carbon atoms; R_2 is a hydrogen atom, a hydroxyl group or a methyl group; and R_3 is a hydrogen atom or a hydroxyl group.

4. The process according to claim 3, wherein acetaldehyde is used in an amount ranging from 0.5 molar equivalents to 3.0 molar equivalents based on an amount of the compound represented by General Formula (1), General Formula (2) or General Formula (3).

5. The process according to claim 4, wherein D-2-deoxyribose-5-phosphate aldolase is used at a ratio of 0.1 U/mmol to 80 U/mmol (1 U represents the amount of enzyme which decomposes 1 μmol of D-2-deoxyribose-5-phosphate into D-glyceraldehyde-3-phosphate and acetaldehyde at 25°C in 1 minute), relative to the total number of moles of the aldehyde compound represented by General Formula (1), General Formula (2) or General Formula (3), and acetaldehyde.

6. The process according to claim 5, wherein the aldehyde compound represented by General Formula (1), General Formula (2) or General Formula (3) is an aldehyde selected from acetaldehyde, chloroacetaldehyde, glycolaldehyde, propionaldehyde, butylaldehyde, isobutylaldehyde, 3,4-dihydroxybutylaldehyde, malonate semialdehyde, succinate semialdehyde and adipate semialdehyde.

7. A process for producing a hydroxyaldehyde compound, comprising conducting aldol condensation of a substituted or unsubstituted aliphatic aldehyde compound having 2 to 6 carbon atoms with two molecules of acetaldehyde to produce a hydroxyaldehyde compound having the number of carbon atoms increased by four, using D-2-deoxyribose-5-phosphate aldolase (or cells containing the enzyme or a lysate thereof) having a property of retaining 50 % or greater of activity after treating at 25°C for 30 minutes in an aqueous medium containing 100 mM of chloroacetaldehyde.

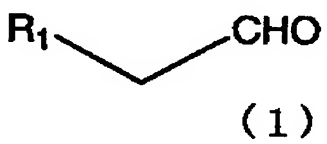
8. The process according to claim 7, wherein the D-2-deoxyribose-5-phosphate aldolase has a feature of either (1) or (2) in the following:

(1) Having an amino acid sequence of SEQ ID NO: 2 or SEQ ID NO: 4; and

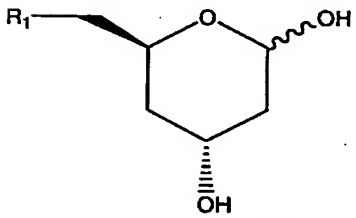
(2) Having an amino acid sequence of SEQ ID NO: 2 or SEQ ID NO: 4, in which one to several amino acids are deleted or

substituted by other amino acid residues, or other amino acid residues are inserted.

9. The process according to claim 8, wherein the substituted or unsubstituted aliphatic aldehyde compound having 2 to 6 carbon atoms is a compound represented by General Formula (1), and the hydroxylaldehyde compound having the number of carbon atoms increased by four is a compound represented by General Formula (7):



(1)



(7)

wherein in General Formula (7), R_1 is a hydrogen atom, a hydroxyl group, a halogen atom, an azido group, a carboxyl group, or an alkoxy group having 1 to 4 carbon atoms.

10. The process according to claim 9, wherein D-2-deoxyribose-5-phosphate aldolase is used for the reaction at a ratio of 0.1 U/mmol to 120 U/mmol (1 U represents the amount of enzyme which decomposes 1 μmol of D-2-deoxyribose-5-phosphate into D-glyceraldehyde-3-phosphate and acetaldehyde at 25°C in 1 minute), relative to the total number of moles of the compound represented by General Formula (1) and acetaldehyde (in General

Formula (7), R_1 is a hydrogen atom, a hydroxyl group, a halogen atom, an azido group, a carboxyl group, or an alkoxy group having 1 to 4 carbon atoms).

11. The process according to claim 10, wherein the compound represented by General Formula (1) is an aldehyde selected from acetaldehyde, chloroacetaldehyde, glycolaldehyde, propionaldehyde, butylaldehyde, 3,4-dihydroxybutylaldehyde, malonate semialdehyde, succinate semialdehyde, and adipate semialdehyde.